Open Source Software can Improve the Health of the Bank Balance - The Beaumont Hospital Experience

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Abstract

This study describes the implementation of open source software in a large Irish public sector organization, Beaumont Hospital. The findings reveal a radical shift in open source deployment from invisible horizontal infrastructure systems to highly visible vertical applications. The case study describes the implementation of these systems, the difficulties encountered, and also the benefits in terms of astonishing cost savings of €13m over 5 years. These details are useful in that few studies have thus far quantified the savings from the deployment of open source software (OSS). Given that Beaumont were already receiving academic pricing discounts for many of their original proprietary closed source applications, the savings for a typical commercial organization could be even higher. Also, in many cases, the extra functionality available in the OSS systems deployed allowed for a richer feature set overall. The study also identifies the primary drivers in the move to OSS, namely principle, pragmatism and practicality. This is useful, since while several studies have considered the motivation of OSS developers, the motivation of actual users of OSS has received far less attention. The study also indicates how a typical company can contribute back to the OSS community in their own unique way, by distributing applications form their own domain of expertise, rather than having to make detailed code contributions to the original code base.

1. Introduction

Open Source Software (OSS) has seen phenomenal success since the term was introduced in 1998. Up to now, most OSS deployments have been in invisible infrastructure applications running on back-office servers: the GNU/Linux operating system, the Apache web server etc.

These were deployed by tech-savvy IT personnel, who were persuaded of the quality of the products, and were not susceptible to any FUD[1] scare tactics. Given that the purchase cost of these products was more or less negligible[2], IT personnel were able to quietly deploy these products. If management had been made aware that most of their vital infrastructure was based on software that was not supplied by a vendor with a legal responsibility for ensuring its performance and continued support, it is most unlikely that the use of these products would have been sanctioned.

In more recent times, OSS products have started to be deployed in more visible applications, desktop applications for word processing, spreadsheet, email etc. Also, the OSS phenomenon is now moving from horizontal infrastructure back-office systems (Ghosh & Prakash, 2000) and now producing applications in vertical business sectors, an X-Ray imaging system in the case of Beaumont Hospital, as will be discussed later. Although it has not always been plain sailing, as the case will illustrate, it is interesting and noteworthy that Beaumont, buoyed by their overall positive OSS experience, are now considering developing some applications, such as Payroll, in an open source fashion using XBRL (eXtensible Business Rules Language) to model these applications as a set of business rules. The OSS experience has been very successful in Beaumont, achieving savings of circa €4.7 million in the first year, and a further €8.3 million in continued savings on an ongoing basis over five years.

The paper is structured as follows: In the next section, contextual background information is provided in relation to Beaumont Hospital, and the case study research method is also discussed. Following this, section 3 discusses the move to OSS, in terms of the significant drivers and the actual experience. Section 4 considers the lessons learned from the process in terms of difficulties and success factors.

[1] FUD is an acronym for Fear, Uncertainty, Doubt, and it represents a 'dirty tricks' strategy which has been used particularly in the computer industry to help undermine competitors (see Irwin, 1998).

[2] It is a common misconception that OSS is of no cost. However, OSS and its almost identical counterpart, Free Software, intend the term 'free' to connote 'freedom' rather than 'no cost.' In English the term is ambiguous, but not in many other languages which have different words for 'freedom' and 'no cost'. Thus, Libre Software is the term commonly used in Europe. However, in this paper for the sake of simplicity and widespread usage, the term OSS is used.

2. Background – The Beaumont Hospital Context

Opened in 1987, Beaumont Hospital was formed from the amalgamation of three of the oldest hospitals in Ireland. Beaumont serves as the training hospital for the Royal College of Surgeons in Ireland (RCSI) and Dublin City University (DCU). In the early days, hospitals in Ireland were largely funded by charitable requests. The State only became involved in the provision of hospital care in the late nineteenth century – and then on a gradual basis. It is somewhat ironic that in the current economic climate – the hospital is again focused on supplementing its revenue funding from charitable donations. In the current year (2003) the hospital faces a €17 million budgetary shortfall – in common with the other four major teaching hospitals in Dublin.

Beaumont employs 3,000 staff directly. The current IT environment features 36 Intel-based servers – 22 running Red Hat or SuSE Linux and 14 running Microsoft Windows NT. In addition to the Intel servers, Beaumont's primary clinical application is based on a HP 3000 mainframe computer. Its finance applications run on a HP Unix system – so the overall environment is characterised by a heterogeneity of application platforms and associated servers. The hospital has always followed a mixed-market policy, acquiring software solutions where these were readily available and suitable, and creating or modifying existing applications where these either did not exist or had to be adapted to fit the working environment of the staff. This mixed-market philosophy extends to the range of application providers who are involved in business relationships with Beaumont. This includes HP, IBM, Sun, Linux providers (Red Hat and SuSE) and Microsoft.

Beaumont has approximately 1,000 desktop machines to support. Approximately one third of these are bordering on obsolete, specified at 64 MB RAM or less and with clock speeds of less than 300 MHz. This situation arises because of a relatively low level of funding to sustain its IT infrastructure. A recent evaluation of the health service in Ireland observed that:

> "it is hard to conceive of an operation of such complexity as health…being managed effectively with the current minimum level of funding of information systems" (Deloitte & Touche, 2001).

As a direct consequence of this, as money became available, Beaumont acquired a variety of software of different vintages and capabilities, including a mixture of packages, such as MS Word 2, MS Word 6, WordPerfect, WordPerfect for Windows, QuattroPro, AmiPro. This in

itself created problems as staff who moved department usually insisted on bringing their familiar desktop applications with them.

2.1 Research Method

Given that the open source software domain is relatively new, much research of an exploratory and descriptive nature is needed, and any research method chosen should reflect this. Marshall and Rossman (1989) propose a framework for matching research purpose with research methods and data capture techniques. In the case of research which has a descriptive and exploratory focus, a combination of case study and in-depth interviewing is deemed appropriate according to their framework.

2.1.1 The Case Study Method

The case study is not viewed in a similar fashion by all researchers (cf. Smith, 1990). However, according to one of the more common interpretations, it describes a single situation, and usually involves the collection of a large amount of qualitative information (cf. Benbasat *et al*., 1987; Lee, 1989; Yin, 1989). Case studies can be very valuable in generating an understanding of the reality of a particular situation, and can provide a good basis for discussion. There is no attempt at experimental design nor any control of variables. As much data as possible is gathered on the presumption that it might prove useful, and also because it is difficult to go back for more information later. However, since the information collected is often specific to the particular situation at a particular point in time, results may not be generalisable.

Notwithstanding this limitation, the case study was chosen as the research method for this study, as its advantage in providing 'thick description' was seen as outweighing its limitations. Also, the IT manager subsequently became a co-author of the paper. Thus, the findings are further strengthened through the direct validation of those responsible for the process being studied.

2.1.2 In-Depth Personal Interviews

The purpose of the personal interview is to encourage the interviewee to relate experiences and attitudes relevant to the research problem (Walker, 1988). It is a very flexible technique in that

the interviewer can probe any interesting details that emerge during the interview, and concentrate in detail on particular aspects.

It should be noted that a *reflexive* approach was deliberately allowed in the interview phase adopted in this study. This has been identified as important in exploratory research (Trauth & O'Connor, 1991) as it allows for refocusing as the research progresses. Responses to certain questions can stimulate new awareness and interest in particular issues which may then require additional probing. Eisenhardt (1989) also recommends such a strategy, labelling it "controlled opportunism".

In this study, a series of formal and informal interviews were conducted over a six-month period with the IT manager and key staff responsible for the OSS implementation at Beaumont, and also with key users of the systems. Interviews were generally of a one to two-hour duration. Informal interviews were used to clarify and refine issues as they emerged. Also, as one of the primary sources of information became a co-author of the paper, the correctness of the researchers' interpretation was less of an issue than in the traditional model whereby exclusively-external authors interpret the research findings.

3. The Move to OSS

In this section the OSS solutions deployed in Beaumont are described initially. Following this, the main drivers in the move to OSS are identified and discussed.

3.1 OSS Solutions Deployed

A range of OSS applications were deployed, ranging from invisible infrastructure systems, Red Hat Linux, to more visible desktop applications such as Star Office, SuSE mail. This move to the deployment of more high-profile OSS products marks a radical shift in the early focus of OSS systems (cf Raymond, 1999). The implementation of each of these systems is discussed in more detail below.

Desktop Applications

In February 2002, Beaumont began a roll-out of the Star Office 5.2 desktop suite. This deployment was very problematic for users and the technical staff. Indeed, the latter became very

disenchanted with the implementation. However, this was felt to be largely due to problems in the version of Star Office. In September 2002, Star Office 6.0 was deployed with some support from Sun. However this implementation was also troublesome. The IT Manager wanted to pursue a thin client strategy based around the concept that all applications should be downloaded from the network where practical. But however attractive as a concept, this failed in practice in the 10 MB shared Ethernet infrastructure environment in Beaumont. The Star Office package was initially loaded onto a single Linux server, but this became overwhelmed, and was then clustered to sustain a dual server strategy. Despite this, users continued to lose network connections in an unpredictable fashion. This inevitably increased frustration and tension amongst the entire workforce who were dependent on these tools. The IT Manager conceded that:

> "we stuck with the network solution too long. It was only after a series of ferocious encounters with users – and with my own staff – that I recognised that we had to shift".

So although it would conflict with a purist architectural dogma, Star Office was reinstalled on the desktop instead for those who wanted it. While this move did not immediately ameliorate the users' perception of the problem, it did over a number of months have a marked impact on the overall level of satisfaction with the solution.

Interestingly, a number of users – who either already had current alternative products or the money to purchase them – opted not to install Star Office. Approximately 80 users (about 8%) of the installed base made this choice. However the IT Manager has informed them that this would have consequences in that they will have to assume responsibility for ensuring that the hardware which they use is upgraded, and provide resources for future maintenance upgrades, etc.

One of the unexpected benefits of this solution has been the capacity of Star Office to exploit its in-built XML capabilities. This is a very powerful feature of the application which enables documents to be structured in such a way that processing logic is built into different sections of the document, i.e. an on-line HR form request, for example, which is then automatically routed to the HR department for processing. This is a significant new feature and provides additional functionality over what was previously offered.

Content Management System

Beaumont's content management system (CMS) is based on the Digital Creation's Zope. The product itself may be downloaded for free, but the implementation in Beaumont cost €20K in terms of support from a small software company, OpenApp, who specialise in brokering OSS solutions. Interestingly, while the OSS phenomenon is sometimes characterised as a threat which will stifle the local software development industry (cf Villanueva, 2002), it is certainly the case that agile SMEs (small-to-medium-sized enterprises) all over the world are leveraging the innovative OSS model to create new business opportunities.

Beaumont's CMS has been customised by OpenApp and provides information such as HR policies, laboratory standard operating procedures, personnel and nursing on-line forms, minutes of working group meetings, multi-disciplinary patient care documents, etc. The Zope application server enables these documents to be managed in an automated manner by using the metatags associated with each document type. Metatags enable the characteristics of a document to be defined independent of its actual content, and contain rules about how information should be displayed, who is authorised to see it, who can change it, etc. This approach is supplemented by close integration with the Beaumont's LDAP directory server where details of every individual employee is held. Based on the their employment category or membership of a specific group, employees are granted corresponding privileges on the CMS server. Overall, the experience has been very positive, with the IT manager observing that:

> "Zope provides us with a tool which is somewhat analogous to a Swiss army knife. It does document management, work flow, supports our Intranet, enables an in-house market-place, enables us to broadcast emergency update messages, i.e. the latest SARS news, etc. – all within the one framework. We have trained one of our own staff to maintain it – as I anticipate that there will be continued demand to expand and grow this capability, as the user community realises what it can achieve.

Many organisations face issues in relation to content management. In Ireland, the Freedom of Information legislation (1999) mandated all affected Government/State agencies to publish details of their relevant operational policies and procedures. In line with this, a group of other health agencies have collectively invested about €1 million to implement a CMS.

PACS[3] – X-ray Imaging

X-ray technology has been a key part of medical treatment since 1895. Until relatively recently most x-ray images were actually printed on film for viewing on light-boxes (analog mode). Now the majority of x-ray modalities generate digital images. These can be used to generate film, while simultaneously creating an image which can be stored for subsequent retrieval and viewing. An international standard, DICOM (Digital Imaging and Communications in Medicine), has defined a standard way for creating and storing such images. In Beaumont Hospital there has been a gradual equipment replacement policy where aging analog machines are being replaced by modern digital equivalents. Recognising this reality, the Senior Medical Physicist in Beaumont applied to Sun Microsystems for research funding to examine the feasibility of storing and retrieving these images digitally. Sun granted Beaumont a Sun Fire V880 with circa 1 TB of disk storage. IT staff in Beaumont then developed a solution to enable the digital images to be retrieved and viewed online. This involved the writing of Perl scripts to extract a DICOM worklist from the existing HP 3000-based radiology information system.

Another hospital in Ireland with an equivalent number of beds incurred expenditure of circa €4.3 million in implementing a commercial PACS system. It is important to appreciate that there are three significant differences between the two solutions. Firstly, the commercial PACS solution included a separate network to display images in clinical locations. Secondly, it also included a number of high resolution monitors to enable diagnostic decisions to be made by radiologists from these images. Finally, as indicated above, the proprietary solution is separate from the other application systems running – requiring a user to effectively utilise two work stations to get an overview of the total clinical picture pertaining to a specific patient. By contrast, the Beaumont provides a singular view with the image integrated with other relevant results data.

It is acknowledged that Beaumont will need to incur expenditure on upgrading the quality of its network to sustain rapid retrieval of data. The cost of this is estimated at circa €250,000. It is also acknowledged that additional high resolution work stations will need to be purchased to sustain radiologist's making clinical diagnosis in a manner which is both safe and consistent. Expenditure on these items is likely to be in the region of €400,000. However the hospital is

[3] Picture Archive and Communications System – a term commonly used to describe the sub-systems used to display,

currently incurring annual costs on x-ray film in the region of circa €480,000. So funding for this additional investment should be capable of being generated through internal savings – once a decision is made to proceed in this manner.

Perhaps the most significant development is that the hospital has acquired experience in utilising digital image technology for a relatively low cost. Other organisations who have committed to large scale investments have been obliged to do their learning in this area in the context of expensive commercial contracts, where modifications and changes have consequential impact on both project schedules and budgets. The Medical Physicist who initiated the whole process is very upbeat stating that "we believe that this is a better way to learn".

Application Server

Beaumont has committed to the development of JAVA/J2EE as its principal reference architecture for software construction. As part of the deployment of JAVA-based solutions it examined a number of applications server solutions. This is a marketplace which is dominated by a number of large players such as Oracle or IBM's Web Sphere suite. The cost of these solutions range in the region of €150,000 to €400,000 for a typical dual-CPU server implementation. Beaumont Hospital selected the open source JBOSS product which is freely downloadable (www.jboss.org). They have incurred expenditure of circa €10,000 in set up consultancy, and expect to incur annual maintenance costs of roughly the same amount for the next five years.

E-Mail

Like many large organisations, Beaumont has been using e-mail for internal and external communications, and held an 800-user licence for Lotus Domino. There was a demand from the organisation to expand the coverage of e-mail to cover all 3,000 staff, but the cost of achieving this was beyond the tight budget available. A search for an alternative e-mail solution was instigated and SuSE Mail was selected (www.suse.com). According to the Lead Computer Operator who managed the implementation, this provides all the basic e-mail functions which users require, and more importantly, it provides email access to everyone in the organisation, which has been greatly appreciated by the various administrative functions in Beaumont.

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diagnose and report on digital images in hospitals

E-Learning

One of the issues which has to be faced in any large organisation is how to update the skills and knowledge base of the staff in a timely manner. While conventional classroom-based training remains at the core of such an educational process, the logistics of organising such support arrangements are formidable. This manifests itself in problems typically encountered in this area, i.e. classes are arranged but not attended, late cancellations occur reducing the effectiveness of planned group work, individuals attend classes without having done the necessary pre-requisite training, etc.

Recognising these logistical issues, many organisations have sought to support the learning process using a variety of self-paced learning tools. Beaumont investigated a variety of solutions and discussed the issue with colleagues in other academic institutions. However the cost of these solutions was beyond the budgetary reach of the hospital. They then examined the possibilities in relation to open source solutions and discovered Claroline (www.claroline.com)

Claroline is a fully-functioning and fully-featured open source learning tool. It enables content to be created based on specific classes or teams. Students enrol in these classes – in Beaumont's case by entering their user ID and password. They then work their way through the material at their own pace. The course modules are finished by users taking a self-check test which tests their comprehension on the various topics covered. This enables the system trainers to pre-qualify students who are enrolling for classroom based instruction. It also provides a very solid indicator of the real level of interest which an individual has in participating in a course. Beaumont are very happy with Claroline, and the Lead Trainer expressing the view that "it seems to meet most of our requirements and we hope to continue creating material on it and building it into our overall training strategy".

3.2 Drivers in the Move to OSS: Principle, Pragmatism, Practicality (3Ps)

While quite a lot of work has been done on the motivation of individual developers to contribute to OSS projects (e.g. Ghosh *et al.,* 2002, Lakhani & Wolf, 2003), less has been done on the motivations of OSS users. In the case of Beaumont, the IT Manager characterised the decision to

move to OSS as based on 3Ps – principle, pragmatism, practicality. Each is discussed in turn below.

Principle

In terms of principle, the IT manager cited the desire to get the best possible return for the tax-payers' money as the hospital was largely funded from Government funds each year. The actual cost savings were extremely significant as Table 1 illustrates, and the basis for the figures is provided in the sub-sections below. The dearth of research which has quantified the benefits and weaknesses of open source software has been seen as a problem (Russo *et al,* 2003), as few studies have addressed the cost savings issue. One notable exception is the study by Shankland (2002) of Verizon who achieved once-off savings of $6m in moving to OSS desktop. However, one criticism of such studies is that the one-off cost of acquiring software does not reflect the total cost of ownership (TCO) of software acquisition (cf. Villanueva, 2002). Thus, in this study, we sought to present the total costs over a five-year period.

As Table 1 illustrates, the once-off savings of OSS over closed source alternatives are in the order of €4.6m. Furthermore, given that annual maintenance costs are typically about 20% of purchase price, when viewed over a 5-year period, the savings are even more dramatic, in the order of €8.4m. In these calculations, every effort has been made to compare like with like in that the estimate of the comparable costs is based on prior experience in Beaumont or on two alternative estimates. However, it is also worth noting that Beaumont receive academic pricing discounts for many of these applications, thus the costs for a typical commercial organization implementing such proprietary packages would be even higher, and the deployment of OSS alternatives would thus result in even greater savings.

	Open Source Software Solution		**Comparable Closed Source Software Solution**	
Application	**Initial Cost**	**Total cost over 5 years**	**Initial Cost[4]**	**Total cost over 5 years**
Desktop Applications	€27.5K (StarOffice)	€34.7K	€120K (e.g. MS Office)	€288.5K
Content Management	€20K (Zope)	€32.1K	€126K (e.g. Lotus Notes)	€140.2K
Digital Imaging - X-Ray	€150K	€237K	€4.3m	€7.339M
Application Server	€10K (JBOSS)	60.5K	€302K (e.g. Websphere)	€595.3K
Email	€1K (SuSE Email)	€8.7K	€110K (e.g. Lotus Domino)	€175K
Elearning	€1K (Claroline)	€4K	€35K	€175K
TOTAL	**€209.5K**	**€377K**	**€4.883M**	**€8.713M**

Table 1 Comparison of OSS versus Comparable Commercial Proprietary Solutions

Pragmatism

The choice of OSS solutions in Beaumont was largely driven by pragmatic considerations (interestingly, pragmatism featured in the motivations of OSS developers also in the Lakhani and Wolf (2003) study). Beaumont's IT budget had undergone a significant contraction since 2000 in the wake of an increased budget in the lead up to the Y2K, and the IT manager did not foresee much prospect of an improved budget allocation in the near future. So faced with the choice of either reducing the service to cope with these restrictions or looking for alternatives, the focus was on what could be found in the open source market-place. Beaumont's IT staff undertook an extensive phase of desk research over a six-month period. The quality of the exchanges on

source forge and slashdot.org, etc were sufficient to convince the IT manager that OSS was worth investigating further. Some direct experimentation with downloaded OSS programs was then sufficient to convince him that the risk involved was relatively low.

The IT manager considers it fortunate that a number of key staff – particularly in the computer operations department – rapidly adapted to the new OSS environment, and he describes the operations team as the "leaders in the overall adoption of OSS". It also helped that the hospital already had a strong experience of UNIX applications to draw on. So the transition was not as radical as it would have been if the operation experience was simply based on GUI-enabled systems administration. In the words of the Linux Systems Administrator, "We are not afraid of the command line interface". This may be significant as developers in the past have referred to the "exhilarating succession of problem-solving challenges" in installing OSS products (Sanders, 1998), and it is unlikely that non-technical users will be entirely comfortable in installing under such conditions, although the user-friendliness of the install process is improving daily. Beaumont's IT staff have also been very impressed with the scalability/stability of the OSS solutions, and have actually moved a number of DOS-based applications onto Linux, in such a smooth transition that the user community never even noticed the change.

Practicality

In terms of practicality, the IT manager cited the fact that the functionality and the look and feel of the OSS applications was pretty much identical to the conventional proprietary ones. Fig 1a and Fig 1b illustrate the screen images of MS Excel and Star Office CALC spreadsheets, which are strikingly similar. Interestingly, it seems to be the case that even though the functionality provided by OSS products is pretty much identical, users prefer the comfort of an identical interface. Thus, Ximian are currently working on a release of OpenOffice that will clone the MS Office interface, even to the extent that the default format for saving files is the MS one! The comfort factor of a familiar interface should not be under-estimated. One of the key complaints from the administrative staff in Beaumont who moved to an OSS platform was that they feared being de-skilled if they didn't have skills in MS Office applications.

[4] Beaumont Hospital avail of academic discounts for most of these applications

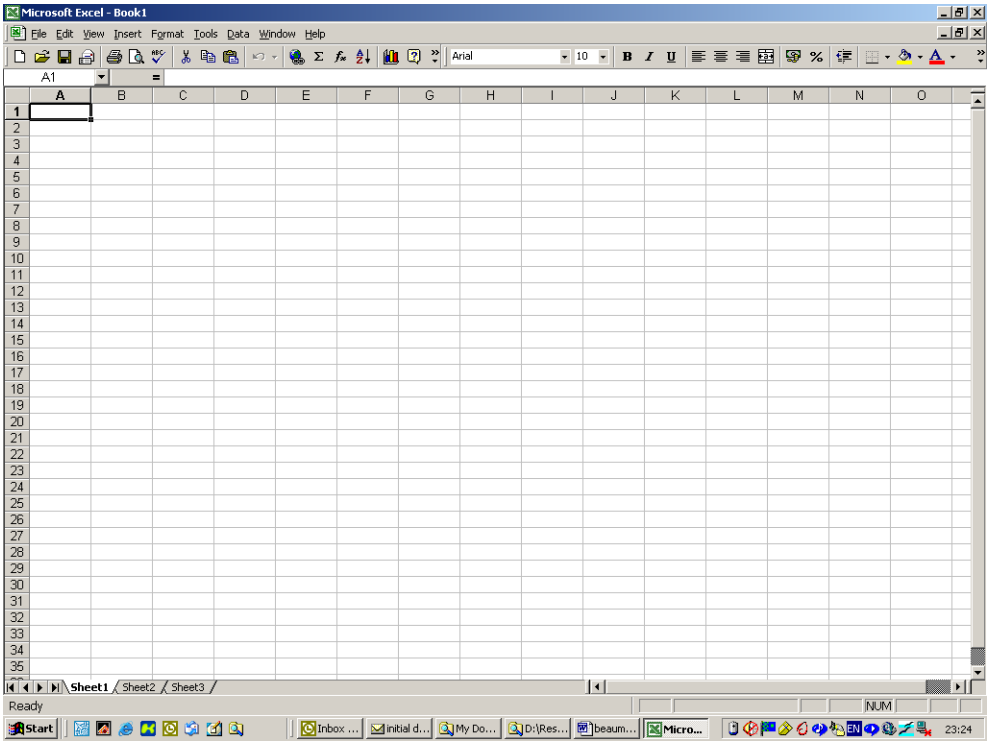

Fig 1a. Microsoft Excel Spreadsheet

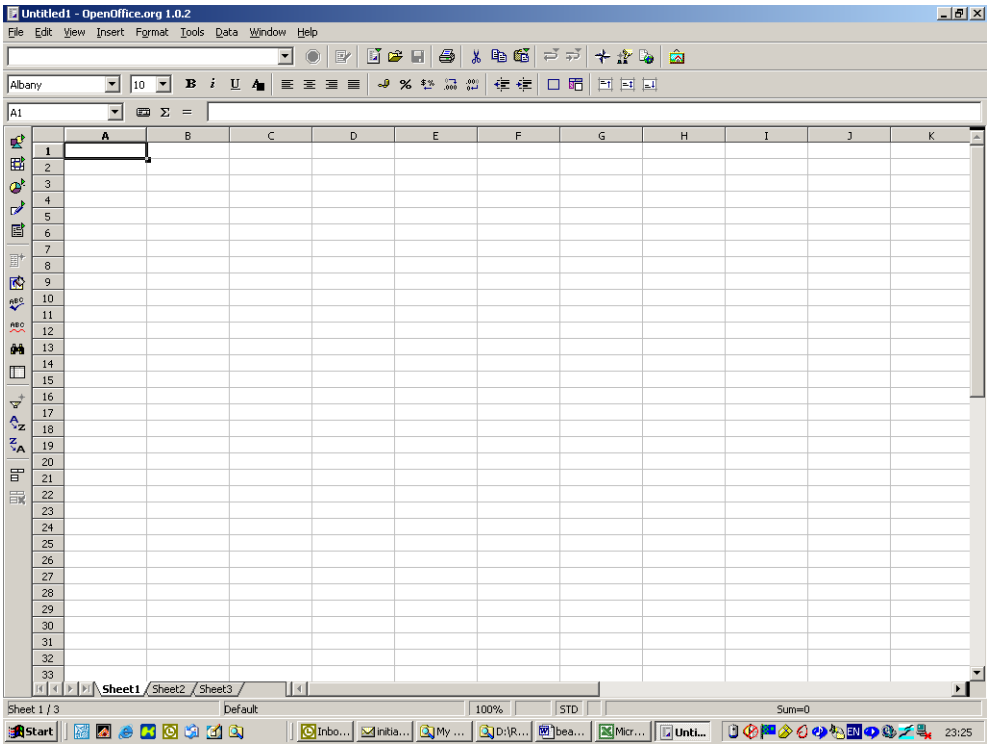

Fig 1b Star Office Calc Spreadsheet

4. Discussion

As already mentioned, in Beaumont's context the drive to OSS was primarily due to the necessity of reducing cost. The IT Manager stated that it was not driven by any doctrine or anti-Microsoft ideology, pointing out that Microsoft was the first to ease Beaumont's budget problems by granting them academic pricing status in 1995. Also, one of the most recent system implemented – to support a comprehensive clinical record for renal patients – was entirely based on Microsoft components. The emphasis on cost reduction in the move to OSS cannot be over-emphasised. Access to source code was not really of interest to Beaumont. In order to get one of their Oracle applications to run, a 5-line fix to Red Hat Linux and a recompile of the kernel was required. However, at the present time, they do not foresee that they will be making modifications to the source code of the products they have deployed. Rather, they will contribute to the OSS community in other ways, as discussed below. The paradoxical issue as to whether many OSS users are actually interested in access the source code is discussed in the OSS literature, where it is labelled the Berkeley Conundrum (Feller & Fitzgerald, 2002). However, one of the strengths of OSS is that access to the source code allows the creation of killer applications in that mass market packages can be tailored precisely to the needs of each customer, but many organisations are not comfortable in making changes to the source code. This suggests that the Free Software Foundation (FSF) definition of free software which stresses four fundamental freedoms, of which access to source code is a precondition for only two (see http:// www.fsf.org/philosophy/free-sw.html) is more relevant to describing the phenomenon. However, in the case of Beaumont, free access to source code was not really weighted highly in their decision to deploy OSS solutions, and the IT manager admits that 'open source software' in the Beaumont case amounts to "zero cost or as cheap as possible".

However Beaumont's IT staff have been very impressed with the capability of OSS solutions on offer, stressing the fact that OSS solutions now extend far beyond the high profile ones of Linux and Apache. This is an important point as it is often assumed that OSS products really only arise in horizontal infrastructure systems, as these represent the most well-known examples (Ghosh & Prakash, 2000), However, as the movement matures, it seems that more visible and vertical applications are being successfully deployed.

4.1 Support and Maintenance for OSS Solutions

The IT manager accepted that OSS-based solutions did not offer the same degree of assurance which a commercially-acquired solution would. There is an element of risk in proceeding on the OSS path:

> "We absolutely have to satisfy ourselves that the solutions that we adopt command a significant following in the OSS community. This is fairly easy to do – just look at the level of postings and on-Source Forge (sourceforge.com) to determine what is active and what is a moribund project"

There is a need for a complete rethink of the support strategy. In the past Beaumont have always purchased support from a competent third party provider. While with OSS this option still exists (i.e. they can get Linux support from HP or IBM), there is a significant difference in expectation associated with the deployment of OSS solutions. Simply because one can download a product off the Web, does not mean it can be used effectively. As the IT manager put it:

> "I downloaded Zope early last Summer and gave it – together with a book I had bought – to a university student who was doing an internship with us. At the end of the Summer he had made very little progress in actually configuring the solution. If we had not involved a specialist consultancy firm – Open App – we would not have achieved the results that we have to date".

Thus, organisations need to be aware that there are support and implementation costs associated with OSS solutions. Also, many organisations may face internal resistance to the fact that their support essentially derives from a series of bulletin boards. They may be equally reluctant to purchase consultancy support to effectively deploy a solution, since, as the IT manager aptly summarised:

> "If you have a product which costs €1 million – it may be appropriate to spend €500,000 on consulting. However if the product costs nothing – then spending €500,000 somehow seems to be a more difficult decision to take".

The biggest learning for Beaumont Hospital has been to orientate its support staff to effectively utilise the Internet and other resources to deliver support. There is still a hankering to call a support number, and have someone else take care of the problem. While the comfort zone which this offers is readily understandable, the IT manager believes that this is a transitional issue, and that as users and developers get more confident in the success of the systems, this will no longer

be a factor. Thus far, the support from online bulletin boards and mailing lists has been very prompt and successful for all the issues they have faced.

4.2 Giving Back to the OSS Community

Notwithstanding their pragmatism overall, Beaumont have subscribed fully to the open source philosophy of openness and sharing, "practicing what we preach" as the IT Manager terms it. In terms of contributing to code development on the installed OSS solutions, the IT Manager acknowledged that the hospital was unlikely to be in a position to contribute to the Linux kernel or to other infrastructural aspects of the OSS movement any time soon. Rather, he stated:

> "We believe that there is space for the sharing of applications – which takes the infrastructural components for granted. In truth, we probably know very little about the internal workings of the Linux kernel but we do understand rostering and dependency and drug prescribing, etc. So this is the area where we would contribute our expertise to the community. In turn, we hope that others will make matching contributions – thereby enriching the pool of resources available to this pressurised, cash strapped community in the health sector.

Beaumont have created a number of applications which it now offers on an open source basis to other healthcare agencies. Examples of these include a nursing dependency system, a tissue matching system and its casualty system. Other organisations have been quite slow in taking up these offers, probably because they are quite uncertain as to how to respond, in the opinion the IT manager. However a number of hospitals have already indicated their interest. One hospital has already installed one of these systems, and two more are waiting until internal resources within Beaumont are available to support their implementations.

Perhaps the most significant application to have been undertaken has been the creation of a rostering system. This supports the process of creating nursing, medical and other rosters, an area which is characterised by a great variation in rules and work practices, and the necessity to ensure that the requisite skills, from a medical and nursing point of view, are available on each shift. There has been a strong demand internally for such a system, primarily from nursing staff, as it is performed in a very time-consuming manual fashion is at present. An interesting aspect of this latter development is that the system incorporates rules based logic – based on using XBRL (extensible business rules language) to express it as a set of business rules. Beaumont intends to

expand this development to incorporate a payroll capability to the rostering system, and to further develop a full payroll system in XBRL for Beaumont, thus saving the €100K annual fee being paid to a bureau service in this area. This is especially interesting as in-house development of payroll systems is unheard of in organisations today.

4.3 Top Management Support

Top management support is also critical for OSS deployment especially as it moves out of the invisible infrastructure systems to visible, high-profile desktop systems. In the case of Beaumont, the decision to move to OSS was given full support by the CEO, largely on the basis that there was no other choice given the cuts in IT capital budget. However, given the high risk involved in venturing into the unknown without the comfort of the traditional hotline telephone support and written maintenance contract, top management support is undoubtedly critical.

5 Conclusion

Strassman (2000) has pointed out that the IT marketplace has always been dominated by a demand for integration. For the first 35 years, he argues that this was provided by IBM, and that since about 1985, Microsoft have performed this function. In both cases they have used their market strategy to generate enormous profits. Beaumont have come to realise that the reach and range of OSS solutions is very considerable, and that much of the integration capabilities offered by proprietary solutions can be equally effectively achieved using open source solutions instead.

As can be seen from the above, Beaumont have made enormous savings, amounting to some €13m over five years through the deployment of OSS solutions. Also, these solutions have been in high-profile user applications, and in many cases a richer functionality than in closed source proprietary alternatives has been achieved. The implementations have not been completely trouble-free, but overall the experience in Beaumont has been very satisfactory. Also, Beaumont have been able to find a way of contributing back to the OSS community in their own unique way by providing systems in the domain with which they have most expertise, thus increasing the potential domains in which ‘developers perceive an itch worth scratching’, to use Raymond’s memorable phrase (Raymond, 1999) all of which bodes well for the future of OSS.

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